

NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3550

MIDTERM EXAM II

6/01 Prof. Powers

- This exam is closed book and notes; notes on four sides of 8-1/2 x 11 paper are allowed.
- There is a 50 minute time limit.
- There are three problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be *sure* to include units in your answers.
- Please circle or underline your answers.
- Do *NOT* do any work on this sheet.
- Show *ALL* work.

1	
2	
3	
Total	

Name: _____

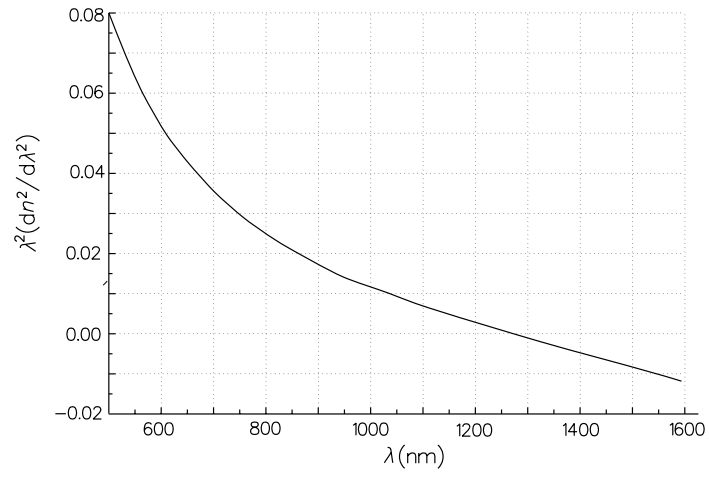


Figure 1: Fig. 3.8 of text

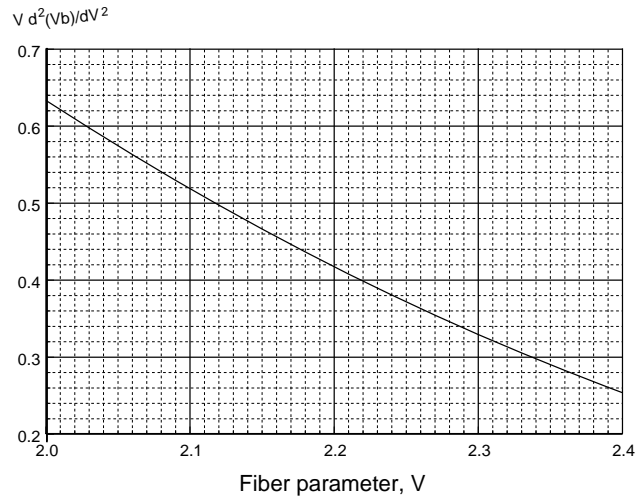


Figure 2: Fig. 3.10 of text

1. We want to couple the light from a 850-nm VCSEL into a 9/125 SI fiber with 60% coupling efficiency. The diameter of the active region of the source is $9\text{ }\mu\text{m}$. The fiber has a core index of 1.460 and a cladding index of 1.455. Calculate the required full-angle beam divergence of the laser to achieve the desired 60% coupling efficiency.

2. An officer-student wants to design a “physical contact” (PC) connector that will join two pieces of multimode fiber having the properties in the table below. Calculate the allowed lateral displacement if the joint loss is to be 1 dB and if the angular alignment losses are assumed negligible.

Parameter	Emitting fiber	Receiving fiber
Size	51/125	50/125
g	1.960	∞
NA	0.190	0.200

3. Consider the data link shown in Fig. 3, operating at 500 Mb/s. The laser source produces $100 \mu\text{W}$ in the fiber at 1300 nm. The parameters for the components are shown in the tables. (Unless specified, the other losses [for example, the losses in the fiber pigtails] are negligible.) We want to focus on the power that is reflected by the splice back into the receiver.

Calculate the signal-to-noise ratio (in dB) at the receiver, assuming that the thermal noise of the load resistor is dominant.

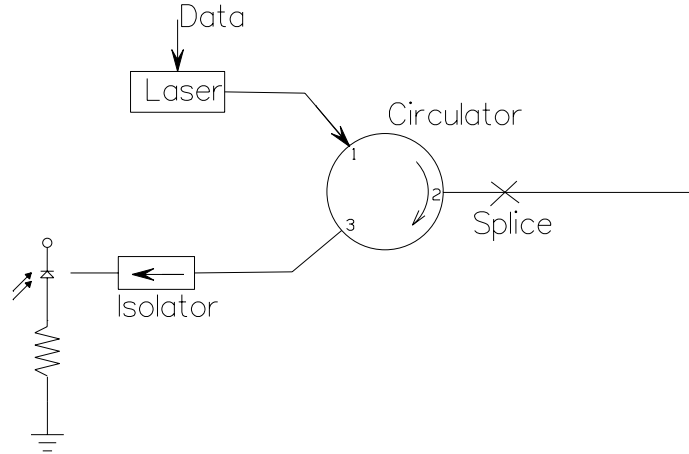


Figure 3: Data Link of Prob. 3.

Splice parameters	
Parameter	Value
Insertion loss	0.2 dB
Return loss	40 dB

Isolator parameters	
Parameter	Value
Insertion losses	1.2 dB
Isolation	50 dB
Return loss	30 dB

Circulator parameters			
Inputs on left; outputs on top			
	1	2	3
1	∞	1.5 dB	90 dB
2	91	∞	1.6 dB
3	1.4 dB	92 dB	∞

Receiver parameters	
Parameter	Value
Quantum efficiency	90%
R_L	100 Ω
Noise temperature	450K